

Bertrand Russell's remark: "It is the privilege of pure mathematicians not to know what they are talking about." Compared to this, the demands upon credulity made by the speculative conclusion advanced in this paper as to life's cosmic function are mild indeed! And it does not require nullification of the first law of thermodynamics, as this postulation of such newly created hydrogen does. What it does require is merely that the evolutionary process should continue to operate precisely as it has through countless millennia and follow the same general pattern with that consistency for which nature is famous.

Brushing aside now the thousand and one objections of detail which can be raised against the pyramid of life concept (most of which seem to have their satisfying answers), let us turn to an aspect of it which may escape notice. It is that through that concept we can have an idea of how the mechanical, chemico-physical world of matter and the

world of animate nature are joined at—so to speak—both ends of the latter. Their differentiation begins when inorganic substance is transmuted into organic. Then the process of building up the grand, mammalian pyramid, supported by lesser, subsidiary ones, proceeds in an ordered manner, gathering and concentrating energy as it rises. It ends in the pyramidal finality of numerical singularity and the fulfillment of its cosmic function by (the electromagnetic forces of?) life. Then, by residual reversion, matter returns to its condition at the starting-point, closing the cycle of this continuous process. Thus do we obtain an idea of the animate and inanimate worlds as complementary phenomena, two interacting, reciprocal parts of one great whole.

Is it not time for cosmologists, mathematical or otherwise, to take notice of the fact that life, too, may be of cosmic significance, and to admit consideration of it into their calculations? It would seem so.

PALEONTOLOGY.—*Notes on some Mesozoic fossil fish remains from Mexico.*<sup>1</sup>

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The remains of two identifiable fossil fishes have been recovered recently from horizons in the sequence of upper Jurassic and lower Cretaceous rocks near Tamán, San Luis Potosí, Mexico. The surprisingly deficient record of marine fishes of these ages in the Western Hemisphere has prompted study of the present materials and suggested the desirability of publishing the following observations.

The region about Tamazunchale and Tamán in the State of San Luis Potosí has attracted the attention of several geologists during the past 30 years. Heim (1926, pp. 84-87, 2 figs.) was the first to offer a gross account of the rock formations outcropping between Tamazunchale, Tamán, and Pimienta, a village on the Río Moctezuma a short distance southwest of Tamán. In the geologic column elaborated from his field

observations, Heim recognized a thick sequence of Jurassic sediments overlain by a limestone which although very similar to the Tamasopo limestone was given the new name Tenestipa formation and considered, according to the ideas of the time, of lower middle Cretaceous age. The Jurassic section was conceived as of two parts; a lower formation called the Tamán beds assigned a Kimmeridgian age on the basis of fossils collected in the valley of the Río Moctezuma at and east of Tamán; and an upper unfossiliferous formation named the Pimienta beds tentatively referred to the Portlandian stage of the upper Jurassic.

Burkhardt (1930, pp. 90-91, fig. 28) in speaking of the Tamazunchale-Tamán section, stated that the Jurassic strata there were simply the northwestern extremity of outcrop of the Liassic and "suprajurassic" formations of the Huasteca region. In addition he considered the highly folded and faulted Tamán beds, reported by Heim as measuring more than 1,000 m in thickness,

<sup>1</sup> The original fish specimens herein described are retained in the private collection of the junior author. Replicas, however, have been deposited in the U. S. National Museum.

to be equivalent to the rocks at Mazapil, Zacatecas, containing *Haploceras fialar* (Oppel) and the bivalve genus *Aulacomyella*. No reference is made by Burekhardt to the unfossiliferous Pimienta beds of supposed Portlandian age.

In Muir's work (1936, pp. 13-15) a transcription of Heim's interpretation of the geology of the area was given with additional information on some cephalopods which had been collected on the newly opened Mexico-Laredo Highway some 10 km. southwest of Tamazunchale and studied by W. S. Adkins. Following this latter contribution, Heim (1940, pp. 332-334) published a second description of the section which was, in general, a repetition of his original conclusions.

Imlay shortly thereafter (1943, p. 1513) expressed the opinion that the region was worthy of thorough investigation in order to determine whether or not valid names for stratigraphic units had been used or if new names should be introduced along with correlations with well established zones elsewhere in Mexico. He subsequently discovered numerous cephalopods in the brown tuffaceous and calcareous beds containing thin bands of black chert along the highway southwest of Tamán. In his opinion (Imlay, 1952, p. 971) these fossils, derived from part of the Pimienta beds of Heim and identified as *Paradontoceras*, *Substeuroceras*, *Himalayites*, *Corongoceras*, *Hildoglochiceras*, *Pseudolissoceras*, and *Durangites*, served to confirm the presence of the Portlandian in the Tamazunchale-Tamán region. In regard to the Tamán beds, Imlay (1952, p. 971) also accepted their Kimmeridgian age as evidenced by fossils (*Haploceras fialar* (Oppel), *Sutneria* sp., *Aspidoceras* sp., and *Aulacomyella* sp.).

In the same year Maldonado-Koerdell (1952, pp. 234-239) gave an account of the stratigraphy of the Tamazunchale-Tamán section, as a result of a systematic search for fossils along the Río Moctezuma and the Laredo highway. Cephalopods, bivalves, and fishes, two of which are described in this paper, were collected, indicating the presence of several levels of Cretaceous and upper Jurassic beds. The following description is a summary of his interpretation of the geologic column between Tamazunchale and

Tamán, including a few kilometers of the highway to the southwest of Tamán.

1. *Méndez shales*. Along the highway in Tamazunchale, and northeast of that town, shales of upper Cretaceous age, with *Globotruncana cretacea*, *Globigerina* sp., *Marssonella oxycona*, *Gumbelina excolata*, *G. globosa* and *Gyroidina* sp., outcrop in exceedingly well preserved condition. The basal portion of the formation, with a certain amount of calcareous beds, should be considered as transitional with underlying strata. The age of the shales is Maestrichtian and Campanian, according to the general consensus of opinion among oil geologists in Mexico.

2. *San Felipe limestone*. Very characteristic layers of uniform thickness, between Kms. 358 and 357 of the Laredo highway, to the southwest of Tamazunchale, are shown in a quarry. Their basal portion is highly folded and faulted. The San Felipe limestone is Senonian in age.

3. *Agua Nueva limestone*. Exposed in the same quarry with the overlying San Felipe and similarly folded and faulted, there are some 15 m of a black, shaly limestone, with pyrite concretions and badly preserved impressions of *Inoceramus labiatus*, of Turonian age.

4. *Tamaulipas limestone*. Underneath shales and limestones of upper Cretaceous age, a thick sequence of a gray, finely grained crystalline limestone, with thin bands of black chert in the higher portion, and a certain amount of shaly and other impurities in the lower portion, outcrops along the highway and the river for more than 20 kms. The limestone is tremendously folded and faulted, but after some familiarity with the section is acquired, it is not difficult to follow downwards the sequence of beds, and to recognize at least two levels or portions in the rocks. The higher portion shows a tendency to maintain the typical lithology of the upper Tamaulipas limestone, while the lower portion is mixed with impurities of diverse nature, and has rounded or flattened concretions of variable dimensions, in more or less abundance, in the lowest levels. Fossils like aptychi of at least two cephalopods, bivalves, and one of the fishes here described, were found in this portion of the limestone, which provisionally has been ascribed to the

Neocomian, in view of positional relationships.

The interval between the lower portion of the limestone and the Tamán beds is everywhere covered in the near vicinity of Tamán, on the highway and the river. Should the Pimienta beds of Heim and Imlay be found close to the village, and their Portlandian age confirmed, their place would come between nos. 4 and 5 of this column.

5. *Tamán beds*. On the bottom of the Moctezuma canyon, east and west of Tamán, well-defined beds of a black-gray limestone of variable dip and strike crop out on the south side of the river. They represent the top of an anticline, oriented from southeast to northwest, and also contain aptychi, cephalopods, and the other fossil fish of this report. Their age is Kimmeridgian.

Order PYCNODONTOIDEA

Family Pycnodontidae

Genus *Gyrodus* Agassiz, 1844

(Refer to A. S. Woodward, 1895, p. 233, for generic synonymy and diagnosis.)

*Gyrodus* cf. *G. macrophthalmus* Agassiz

An incomplete right mandible with complete splenial dentition illustrated in Fig. 1, exhibits well the fundamental characteristics of the assigned genus.

The presence of an associated dentary element is uncertain. As incompletely preserved and exposed in ventral aspect, the splenial bone has an over-all length of 43 mm and a maximum width of 14 mm. The dorsal surface is occupied for about two-thirds of its extent by the tooth studded area. This dentigerous portion appears flat without either transverse or frontal flexure and presents an elongate, trapezoidal outline only slightly broader behind than anteriorly and with the posteriorly diverging mesial and lateral borders of about equal length.

Although showing some small irregularities, all the teeth are generally circular in coronal outline. Each exhibits either an apical pit or tubercle surrounded concentrically by two elevated and mammilated rings. They are set in four regular longitudinal rows. In each of these four linear series the structures show a progressive increase in diameter from front to back. As usual, counting from the symphysis laterally, the second row

contains the largest teeth. The fourth or labial row is made up of the next to the largest. This greater size causes the crowns of the teeth in these two rows to project noticeably above the levels of those of the symphysial and third rows. The symphysial row is composed of 11 well spaced teeth; the second, 8; the third, 10; and the fourth, 9. It is of interest to note that the lateral fourth row has the shortest longitudinal dimension of any in the dental battery. Its component teeth are all flattened on their labial side and the crowns above these lateral points are raised into cusplike eminences which interrupts the continuity of one or both of the concentric mammilated rings.

*Geologic horizon and locality*.—Collected from the type section of the Tamán beds (Kimmeridgian) (Heim, 1926 and 1940) on the right bank of the Rio Moctezuma at the village of Tamán, San Luis Potosí, Mexico, by M. Maldonado-Koerdell and D. H. Dunkle, October 1951.

*Discussion*.—Numerous species of pycnodontid fishes, varying in age from the middle Jurassic to upper Cretaceous, have been referred to the genus *Gyrodus*. The majority of these, unfortunately, have been based on unassociated splenial and vomerine dentitions and defined without adequate information on the quality and quantity of variation shown by the few species known by series of complete skeletons. For the purpose of this report, therefore, no attempt at detailed specific comparisons has been made. The present assignment of this Mexican specimen to the contemporaneous genotypic species *macrophthalmus* is entirely arbitrary although the generic reference cannot by current criteria be questioned.

Two occurrences of *Gyrodus* in the Western Hemisphere are listed by Romer (1945, p. 580). Of these two, the questioned upper Cretaceous occurrence in North America has not been located in the literature. However, the other, upper Jurassic one refers to *Gyrodus macrophthalmus cubensis* Gregory (1923) from the Jagua shales of Western Cuba. This latter pycnodontid fish is very poorly known but extensive series of specimens now available, while showing tremendous variation in dental characters, seemingly differs constantly from the Mexican type, as follows: the labial row of splenial teeth is the longest of the four linear series present and contains the greatest number of component denticles which never appear appreciably enlarged; and the teeth, especially those of the principal row, tend toward

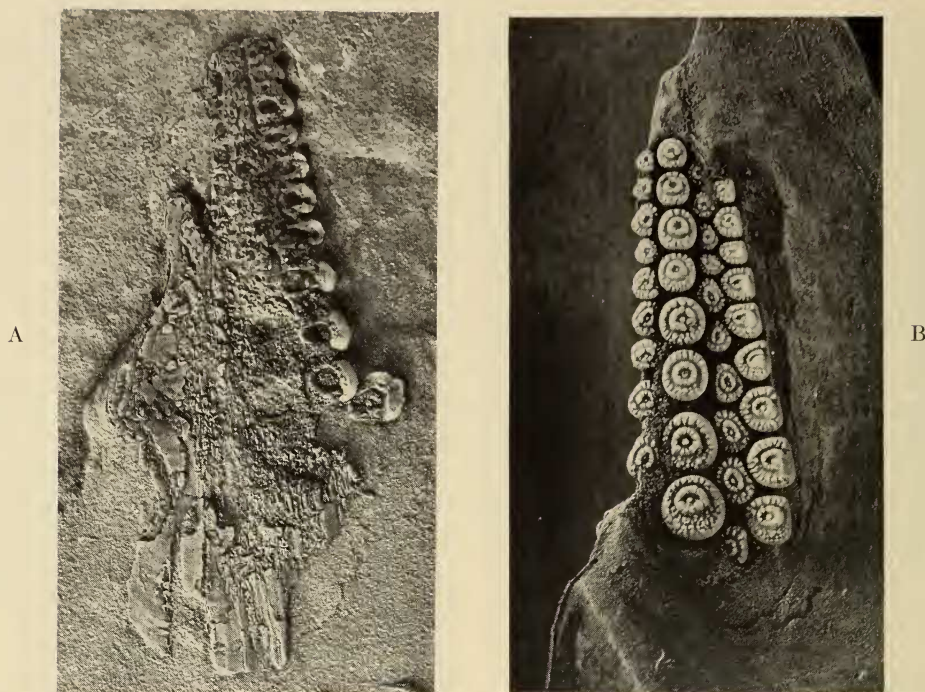


FIG. 1.—*Gyrodus* cf. *G. macrophthalmus* Agassiz. Lingual (A) and crown (B) views of fragmentary right mandible from the type section of the upper Jurassic (Kimmeridgian) Tamán formation at Tamán, San Luis Potosí, Mexico.  $\times 2$ .

an ovoid outline through increase of the transverse diameter of the crowns.

Order ISOSPONDYLI  
Suborder Clupeoidea  
Family Leptolepidae

Genus *Leptolepis* Agassiz, 1832

(Refer to A. S. Woodward, 1895, p. 501, for generic synonymy and diagnosis.)

Genotype: *Leptolepis coryphaenoides* (Bronn).

*Leptolepis tamanensis*,<sup>2</sup> n.sp.

*Diagnosis*.—A leptolepid as shown by anteriorly attenuated frontals and characteristically developed mouth parts which differ from the genotype and all adequately known Jurassic leptolepids from the Western Hemisphere by possession of the following combination of structural features: vertebrae, with minute notochordal perforation, heavily ossified and generally longer than deep; only the last four centra involved in support of the externally homocercal tail; no demonstrable urostyle or uroneurals; the five hypurals supporting the dorsal lobe of caudal fin abutting directly on the last recumbent neural

arch and two spineurals; the four hypurals supporting the ventral lobe arising from the last three vertebrae; and all 20 of the articulated and branched caudal fin rays hypaxial, and preceded directly both dorsally and ventrally by series of small fulera-like spinelets.

*Holotype*.—An incomplete fish on slab of tuffaceous matrix showing major visceral components of the head and an articulated series of vertebrae with attached caudal fin; from the lower Cretaceous (Neocomian) beds at Kilometer 342 + 650 on the Mexico-Laredo Highway, above the village of Tamán, San Luis Potosí, Mexico; collected by M. Maldonado-Koerdell, August 1951.

*Description*.—The structural details of the one known specimen on which this type description is based are somewhat obscured by secondary mineralization. Accurately discernible, however, are the major visceral components of the head, a cleithrum, and an articulated series of vertebrae with attached caudal fin. Compared with the averaged dimensions of several species of *Leptolepis* an elongate fusiform fish is indicated with head occupying perhaps 20 mm of a standard length estimated as about 90 mm.

The form and disposition of determinable skull elements are illustrated in Fig. 2. Characteristic

<sup>2</sup> Named for the village of Tamán, San Luis Potosí, which is near the occurrence of the holotype.

of the family to which the form is referred are the anteriorly attenuated frontals; the small premaxillary; the maxillary with anteriorly constricted neck and posteriorly convex oral border; and the distinctive, dorsally produced dentary. The orbit appears to have been large and situated

centrally in the length of the head. The angle of the lower jaw lies below the middle of the orbit. The maxillary was probably of normal leptolepid size, although as preserved overlain by the mandible, its observable extent scarcely equals the preorbital length of the skull. Teeth are not to

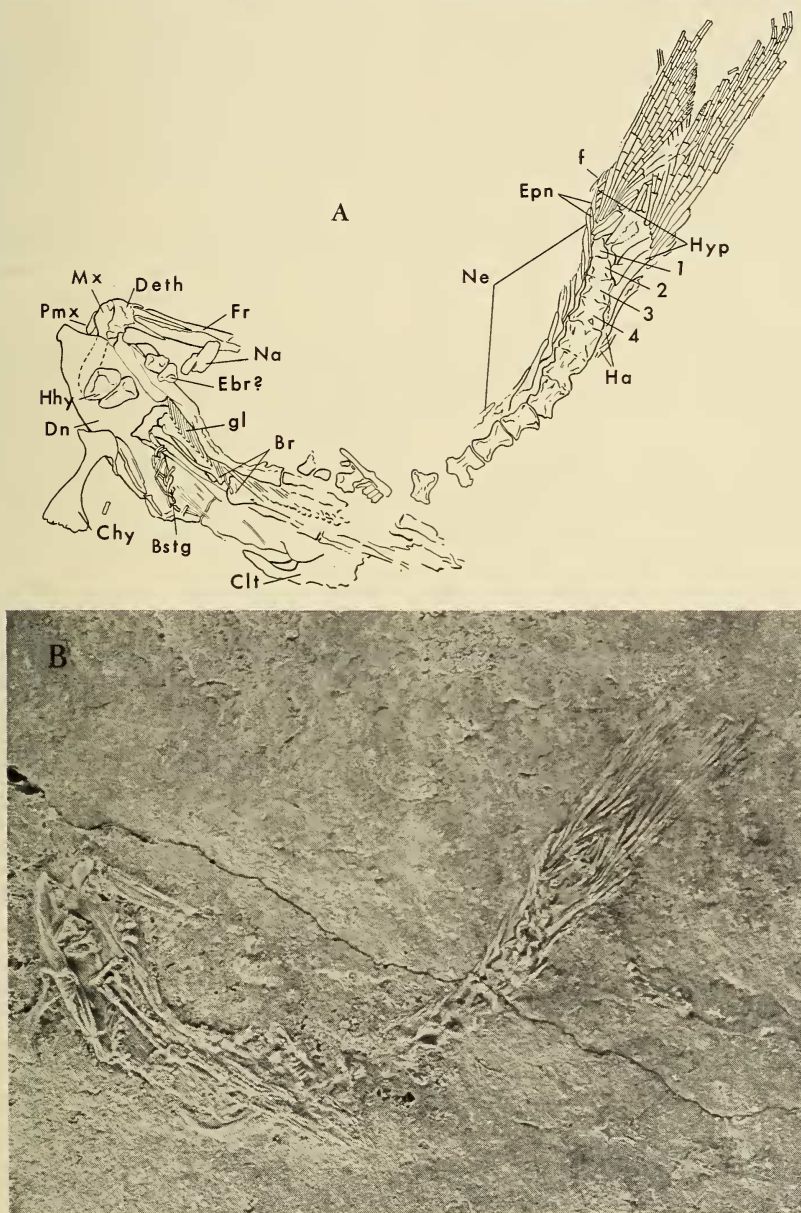


FIG. 2.—*Leptolepis tamanensis*, n. sp. Habit sketch (A) and photograph (B) of specimen as found, in here interpreted lower Cretaceous strata, at Kilometer 342 + 650 above Tamán, San Luis Potosí, Mexico.  $\times 2$ . (Legend of abbreviations: Br, branchial arch elements; Bstg, branchiostegal rays; Chy, ceratohyal; Clt, cleithrum; Deth, ?mesethmoid plus dermethmoid; Dn, mandible; Ebr?, paired epibranchial elements; Epn, epineurals; f, spinelets in advance of both dorsal and ventral caudal rays; Fr, frontal; Hhy, paired hypohyals; Hyp, hypurals; Mx, maxillary; Na, nasal; Ne, neural arches; Pmx, premaxillary; and 1, 2, 3, & 4, respectively, the last and anteriorly preceding 3 vertebrae centra involved in support of caudal fin.)

be seen on any of the mouth parts. An undoubtedly incomplete series of eight strongly arched and rodlike branchiostegal rays lie adjacent to the ventral border of the right ceratohyal. Long, slender, and closely set parallel rods extend from the surfaces of several of the branchial elements and seem best interpreted as gill raker supports.

The cleithrum exhibits a prominent longitudinal ridge and a relatively large postero-ventral expansion.

Preserved vertebrae number 11. All possess an average length of 2 mm, with the exception of the last three centra which are shorter. This length is greater than the depth anteriorly in the series, but progressively toward the rear is equalled and then exceeded by the dorso-ventral dimension. Each centrum appears to have been heavily ossified, with markedly constricted dorsal and ventral margins, and some present evidences laterally of pits above and below a longitudinal strengthening rib. The internal notochordal perforation is minute.

The structure of the tail is externally homocercal. Apparently only the last four vertebrae take part in the support of the caudal appendage. The neural and haemal arches of this region are robust and are inclined backwardly in acute angles from free articulation with the centra to almost parallel the longitudinal axis of the vertebral column. Each possesses a strong forward process which abuts on the next preceding arch. A total of nine hypurals are present. Neither a urostyle nor paired uroneural elements can be discerned. In consequence, the five upper hypurals supporting the dorsal lobe of the fin appear in direct contact with two epineurals and the last neural spine. Of the four hypurals supporting the ventral lobe, two arise from the last centrum and 1 each from the second and third vertebrae from the back. The fourth forwardly succeeding centrum also bears an enlarged haemal arch, which, however, is directed only to the spinelets preceding the fin rays, ventrally.

Observable caudal rays total 20. These, regularly articulated and branching as many as three times, are presumably all hypaxial. The first ray dorsally and the twentieth ventrally are preceded anteriorly by an incompletely preserved series of fulcrum-like spinelets. The fin, in all probability, was equilobate and relative to the degree of posterior emargination, the middle rays have indicated lengths exceeding one-half those of the longest rays.

*Discussion.*—The widely recognized genus *Leptolepis* is comprised of numerous species of fossil fishes from all parts of the world and from strata ranging in geologic age (Romer, 1945, p. 581) from lower Jurassic to the middle Cretaceous. Despite this apparent commonness of occurrence, it is impossible to obtain from an extensive literature either the detailed morphology of most defined forms or the range of structural variation within the population of any given species. In view of such incomplete knowledge and absence of adequate comparative series of specimens, the erection of new species on fragmentary specimens may well appear to be ill advised. However, on the basis of currently employed taxonomic criteria, the present definition of *L. tamanensis* seems warranted. The characters listed in the above diagnosis readily distinguish this Mexican species from the genotype *L. coryphaenoides* (Bronn) (Rayner, 1937). Excluding the Argentine *Leptolepis australis* Saez as too poorly described for comparison, only two other Jurassic leptolepids are known from the Western Hemisphere: *Leptolepis schoewei* Dunkle (1942) from the Todilto limestone (Oxfordian) of New Mexico and *Luisichthys vinalesensis* White (1942) from the Jagua shales (Oxfordian) of Cuba. Affinity between these two and *L. tamanensis* is suggested by the common absence of a demonstrable urostyle and direct abutment of the hypurals supporting the dorsal lobe of the caudal fin on the neural elements. *L. tamanensis* differs specifically from *Luisichthys* in the details of caudal fin structure. It is distinguishable from *L. schoewei* on the same basis but also noticeably in vertebral structure: all available specimens of the species from New Mexico exhibiting poorly ossified diplospondylous ring centra.

#### REFERENCES

- BURCKHARDT, C. *Étude synthétique sur le Mésozoïque Mexicain*. Mém. Soc. Paléont. Suisse 49-50: 280 pp., 32 figs. 1930.
- DE SAEZ, M. D. *Noticias sobre peces fosiles Argentinos*. Notas Mus. La Plata 4(Paleont. 19): 423-432, figs. 1-5. 1939.
- DUNKLE, D. H. *A new fossil fish of the family Leptolepidae*. Sci. Publ. Cleveland Mus. Nat. Hist. 8 (5): 61-64, pl. 6. 1942.
- GREGORY, W. K. *A Jurassic fish fauna from western Cuba, with an arrangement of the families of holostean ganoid fishes*. Bull. Amer. Mus. Nat. Hist. 48: 223-242, 6 figs. 1923.
- HEIM, A. *Notes on the Jurassic of Tamazunchale (Sierra Madre Oriental)*. Ecol. Geol. Helvetiae 20 (1): 84-89, 2 figs. 1926.

- . *The front ranges of Sierra Madre Oriental, from Ciudad Victoria to Tamazunchale*. *Ecol. Geol. Helvetiae* **33** (2): 313-363, 10 figs., 1 geol. map and sects. 1940.
- IMLAY, R. W. *Jurassic formations of Gulf Region*. *Bull. Amer. Assoc. Petrol. Geol.* **27** (11): 1407-1533, 14 figs. 1943.
- . *Correlation of the Jurassic formations of North America, exclusive of Canada*. *Bull. Geol. Soc. Amer.* **60** (9): 953-992. 1952.
- MALDONADO-KOERDELL, M. *Contacto Jurásico-Cretácico entre las formaciones de Tamán y Tamazunchale, Estado de San Luis Potosí, en sus relaciones con la presencia de yacimientos petroleros*. *Mem. Primera Conven. Interame-*
- ricana *Rec. Miner., Mexico*, 1951; 234-239, 1 pl. 1952.
- MUIR, J. M. *Geology of the Tampico Region, Mexico*: 280 pp., 15 pls., 40 figs. Tulsa, Okla., 1936.
- RAYNER, D. H. *On Leptolepis bronni Agassiz*. *Ann. Mag. Nat. Hist., ser. 10*, **19**: 46-74, figs. 1-14, 1937.
- ROMER, A. S. *Vertebrate paleontology*, ed. 2: x + 687 pp., 377 figs. Chicago, 1945.
- WHITE, T. E. *A new leptolepid fish from the Jurassic of Cuba*. *Proc. New England Zool. Club* **21**: 97-100, pl. 1. 1942.
- WOODWARD, A. S. *Catalogue of the fossil fishes in the British Museum (Natural History)* **3**: xlii + 544 pp., 18 pls., 54 figs. 1895.

ENTOMOLOGY.—*Notes, new synonymy, and new assignments in American Gelechiidae*. J. F. GATES CLARKE, U. S. Bureau of Entomology and Plant Quarantine.

August Busck's excellent paper on the restriction of the genus *Gelechia*<sup>1</sup> is limited in scope to the treatment of North American species, although a few from Europe that concerned him are included. His studies were further limited by the unavailability of material, particularly specimens of species described by the late Edward Meyrick. Moreover, he made no attempt to include species from South America, which are an important part of the American fauna.

Since Busck's paper was written, the present writer has had the opportunity to examine the types of many of Meyrick's species and those of other authors. The study of these types has revealed previously unrecognized facts which are recorded in the following notes.

The new assignments and other changes indicated below are based on a study of the genitalia. Extensive revisionary studies in the family are necessary, but the present paper makes possible the proper assignment of the species treated.

The genus *Chionodes* Hübner has not previously been recorded from South America, although one species, *C. leucocephala* (Walsingham), is recorded from St. Croix, West Indies. The genus is holarctic in distribution and also occurs as far south as southern Chile.

#### Genus *Aroga* Busck

*Aroga* Busck *Proc. U. S. Nat. Mus.* **47**: 13. 1914.

<sup>1</sup> *Proc. U. S. Nat. Mus.* **86**: 563-593, pl. 58-71. 1939.

#### *Aroga bispiculata* (Meyrick), n. comb.

*Gelechia bispiculata* Meyrick, *Exotic Microlepidoptera* **3**: 23. 1923.

*Type locality*.—Congress, Ariz.

*Remarks*.—Meyrick compared this with *Lita variabilis* (Busck) to which it bears a slight resemblance but from which it is structurally distinct. The genitalia of *bispiculata* are characteristically those of an *Aroga* and leave no doubt as to its assignment here.

#### *Aroga speculifera* (Meyrick), n. comb.

*Gelechia speculifera* Meyrick, *Exotic Microlepidoptera* **4**: 59. 1931.

*Type locality*.—Hope, Ark.

*Remarks*.—Known only from the type.

#### *Aroga trachycosma* (Meyrick), n. comb.

*Gelechia trachycosma* Meyrick, *Exotic Microlepidoptera* **3**: 21. 1923.

*Type locality*.—Venice, Calif.

*Remarks*.—In this species the harpe is reduced to a mere nodule emitting a moderately strong seta. The aedeagus is unusually robust and the vesica armed with many strong, short cornuti.

#### *Aroga xyloglypta* (Meyrick), n. comb.

*Gelechia xyloglypta* Meyrick, *Exotic Microlepidoptera* **3**: 22. 1923.

*Type locality*.—Venice, Calif.

*Remarks*.—When he described this species Meyrick stated, "Probably allied to *trichostola*." The latter, however, is referable to *Chionodes* as shown by Busck.